EXCEL AND SEQUENCES

Getting Started

Open the Excel file `Excel_sequences.xlsx`. Make sure you are on the first page: Click on the "Medication" tab. (The tabs are at the bottom.) The data that you are given are the amount of a particular medication in the bloodstream of a patient a number of minutes after the medication is injected. Your goal is to make a model for the amount of medication.

You might wish to start by making a graph. Move the cursor to the header for column `A`, then click and drag to highlight both columns `A` and `B`. Click on the "Insert" tab at the top of the screen, then choose "Scatter". (The first format, showing just dots, is fine.) Does the graph help you figure out what kind of model might be best?

You might wish to examine differences or ratios. Put the label "Differences" in cell `C1` and the label "Ratios" in cell `D1`. In cell `C2`, type a formula (all formulas in Excel begin with `=` or `+`) to get the difference between each successive term. In this case, you may type `=B3-B2` (and then press ENTER) to get the difference in the values in cells `B3` and `B2`. Click on cell C2 (which should now read -30). Notice a dark black box at the lower right corner of the cell. Click on that box and drag down to fill out all the differences. Think about where you should stop dragging. See if you can figure out on your own how to fill in the column of ratios.

Based on the evidence you see, do you think additive growth or multiplicative growth might be better for this data? Choose one. You might decide on growth rate by taking an average. For example, the formula `=average(C2:C19)` would give the mean of all the numbers in cells `C2` through `C19`. Think about what an explicit and a recursive model would look like. Click on the respective tabs at the bottom of the spreadsheet to go to clean pages to build one of each. The original data have been copied for you.

Recursive Modeling with Spreadsheets

For a recursive model, you need two things: a start value and a rule for how to proceed. With a spreadsheet, you can place the start value in the first cell (cell `C2`) and be done with the start value requirement. In the cell below the start value, you simply type the rule, starting with `=` or `+`, using the cell address of the row above as the previous value. For example, if your recursive formula said $f(n+1) = 2f(n)+7$ or $f(n) = 2f(n-1)+7$, you could type `=2*C2-7` in cell `C3`. Be sure to use the `*` for multiplication: Excel does not understand the notation `2C2`. Once you have the formula in one cell, you can click-drag to fill in the whole column. Implement your recursive model (additive or multiplicative) in the column marked "Model". Make a new graph by highlighting the first three columns, then click on "Insert" and choose the first scatter plot. You may not be able to tell the points apart, especially if your model is good. Right click on one of the data points on your graph; click "Format Data Series" from the popup menu. Select "Marker Options" and choose "None", then select "Line Color" and choose some color that does not already show up on the graph. Click OK. This will allow you to see one set of data as discrete dots and the other set as a curve.

Explicit Modeling with Spreadsheets

For an explicit model, you need only one thing: a formula that gives values for f in terms of n only. With a spreadsheet, simply type your formula in the top cell. Instead of x or n or t, though, you enter the cell address of the value you want to use for the variable. For example, if your explicit formula said $f(n) = 3n^2 - 5$, you could type `=3*A2^2-5` in cell `C2`. As before, be sure to use the `*` for multiplication. Once you have the formula in one cell, you can click-drag to fill in the whole column. Implement your explicit model (additive or multiplicative) in the column marked "Model".

Residual (or error)

The graph you made probably looks pretty good, and thus you might not think you made any errors. Go to either the Recursive or Explicit page, and go to cell `D2`. In this column, you will measure your errors, or residuals, or the difference between "actual" and "predicted". Since the "actual" data are in column `B` and the "predicted" are in column `C`, you can enter a formula such as `=B2-C2` in column `D2`, then click and drag down. You will see the errors in each prediction. Some may be positive, some may be negative. Obtain a graph of the residuals by highlighting the data (and column label) for "Minute", then control-highlight the residual column (so that the first and fourth columns are highlighted, but not the second and third columns), click on "Insert" and "Scatter plot". The graph you see is a good residual graph if it looks like a random scattering. A pattern to the residual graph indicates that your model is not as good as you would like.